Factors Influencing Loads of Diazinon and Methidathion in the Sacramento and San Joaquin River Watersheds 1992-1994

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Approach

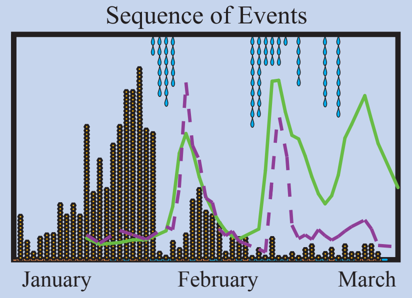
Organophospate insecticides are applied annually to stone fruit orchards in both the Sacramento and San Joaquin River watersheds during the months of December through March. The first rainfall event following pesticide application is consistently accompanied by a rise in measured pesticide concentrations in surface waters. Organophosphate pesticide concentrations measured during this first flush were found to exceed recommended guidelines for water quality in both the Sacramento and San Joaquin Rivers.

Pesticide concentration data were collected from 1991 to 1994 during a study conducted by the U.S. Geological Survey San Francisco Bay Toxic Substances Hydrology Program. Water samples were collected on a weekly to twice weekly basis at two sites, Sacramento River at Sacramento and San Joaquin River near Vernalis, and analyzed by gas chromatography/mass spectrometry.

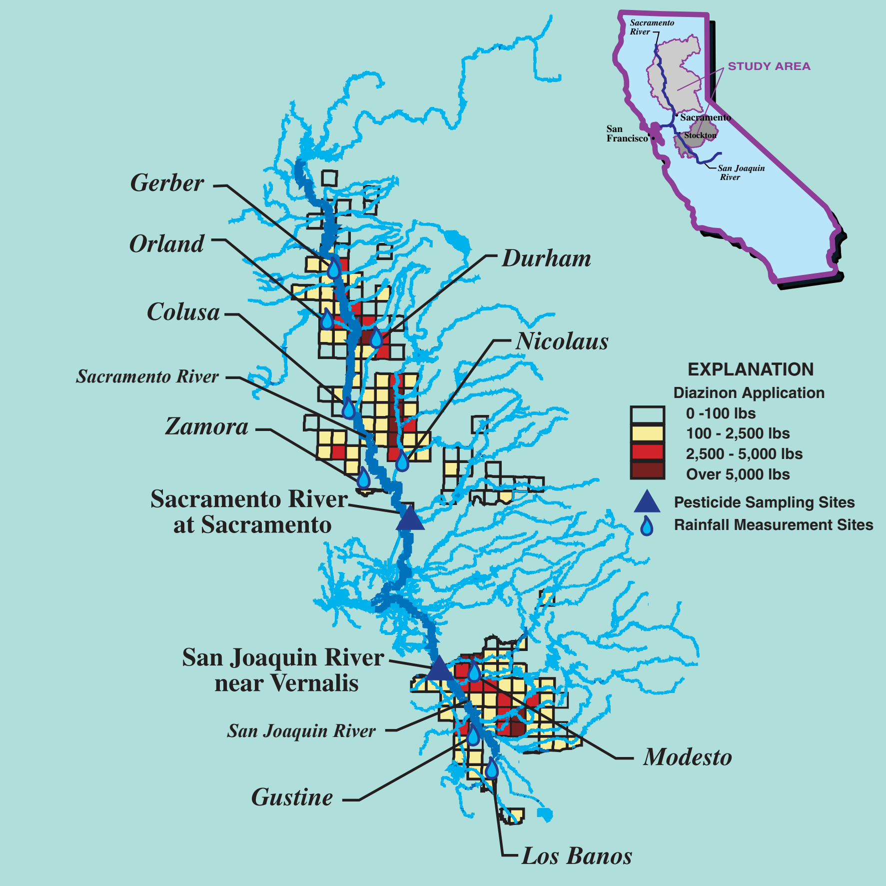
- Pesticides:
  - Diazinon
  - Methidathion
  - Chlorpyrifos
- Primary Crops:
  - Prunes
  - Peaches
  - Walnuts
  - Almonds
  - Cherry
  - Apricot

★ Note the repeated sequence of events application ➡ rainfall ➡ pesticide pulse

Sequence of Events



EXPLANATION
Pesticide application
Rainfall
River discharge
Pesticide concentration



Load Calculations

The first pulse of diazinon and methidathion is graphed for the Sacramento and San Joaquin River watersheds in 1992, 1993, and 1994.

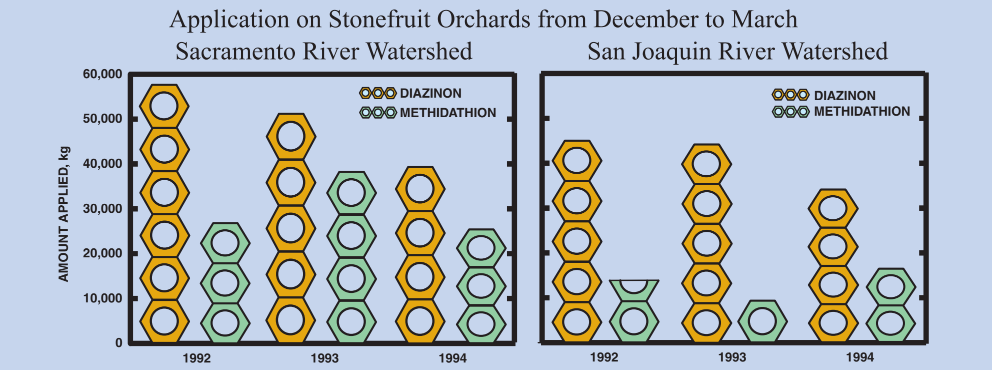
Loads are calculated by multiplying the instantaneous measured pesticide concentrations by the instantaneous discharge at each sampling location.

Diazinon application in kilograms — Pesticide Load in grams per hour — Methidathion application in kilograms

= .1 inch average rainfall — Values calculated as an average of 6 sites for Sacramento and 3 sites for San Joaquin

★ Samples with nondetections assumed to have concentrations of half the detection limit for each respective pesticide

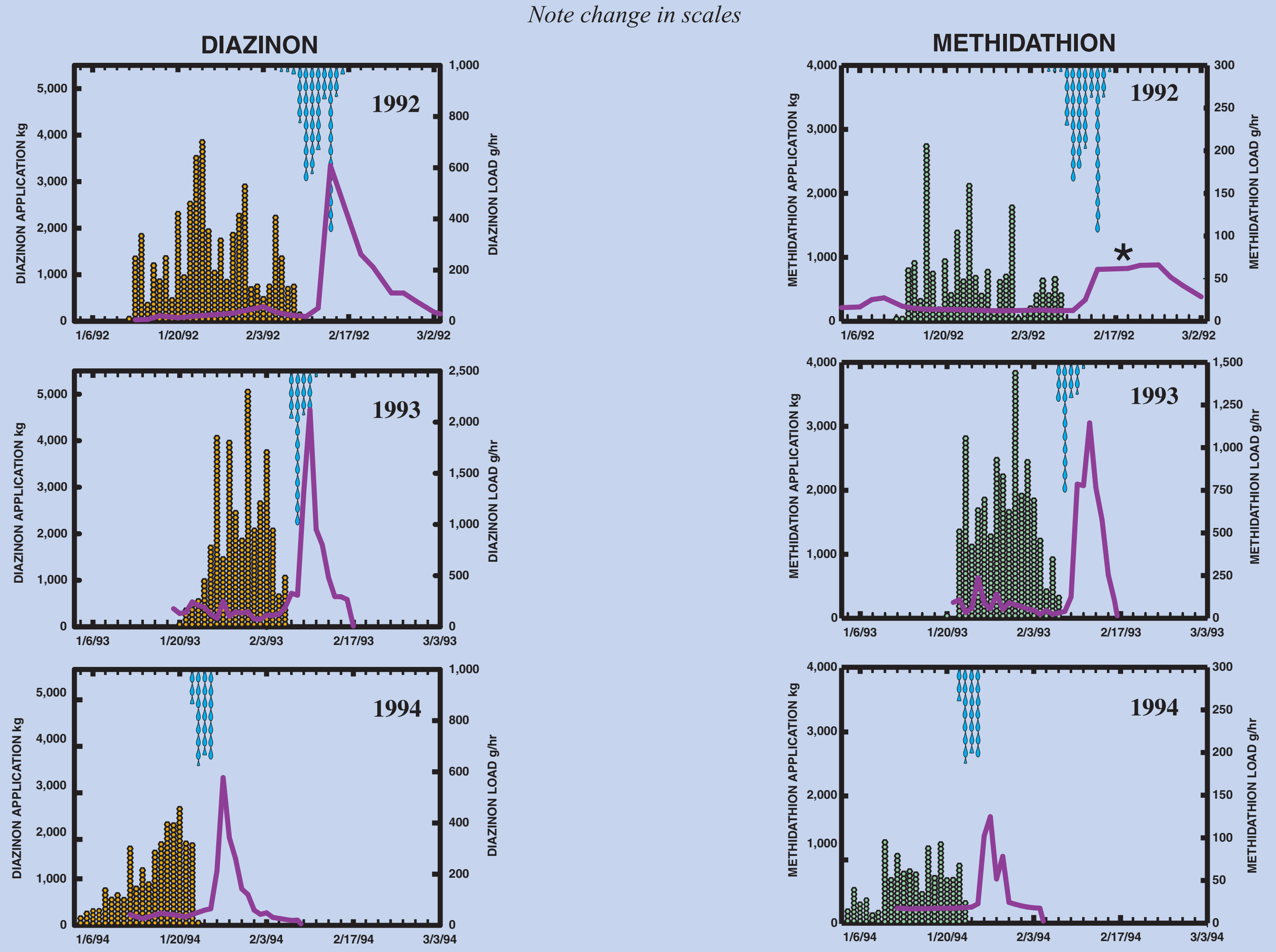
Pesticide Applications



- Overall decline in diazinon application but variable methidathion application in both watersheds
- Less total diazinon and methidation applied in the San Joaquin River watershed

Sacramento River Watershed

Note change in scales

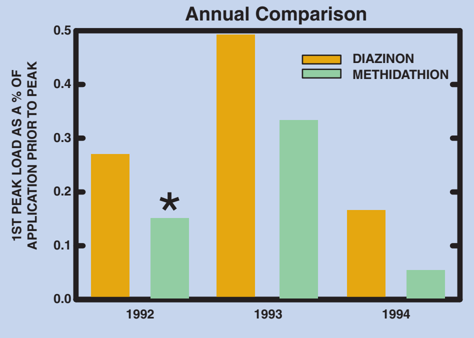


- Pesticide loads vary by an order of magnitude from year to year and between compounds
- Similar yearly trend in load for both compounds (93 > 92 > 94)
- Amount and duration of pesticide application and rainfall vary from year to year

Does application amount alone account for annual variability in load?

- Normalize load to the amount applied (graphed as %)
- % load varies from year to year suggesting other factors are important
- Similar year to year trend for both pesticides (93 > 92 > 94)
- Early trend for load as percent of applied similar to load trend

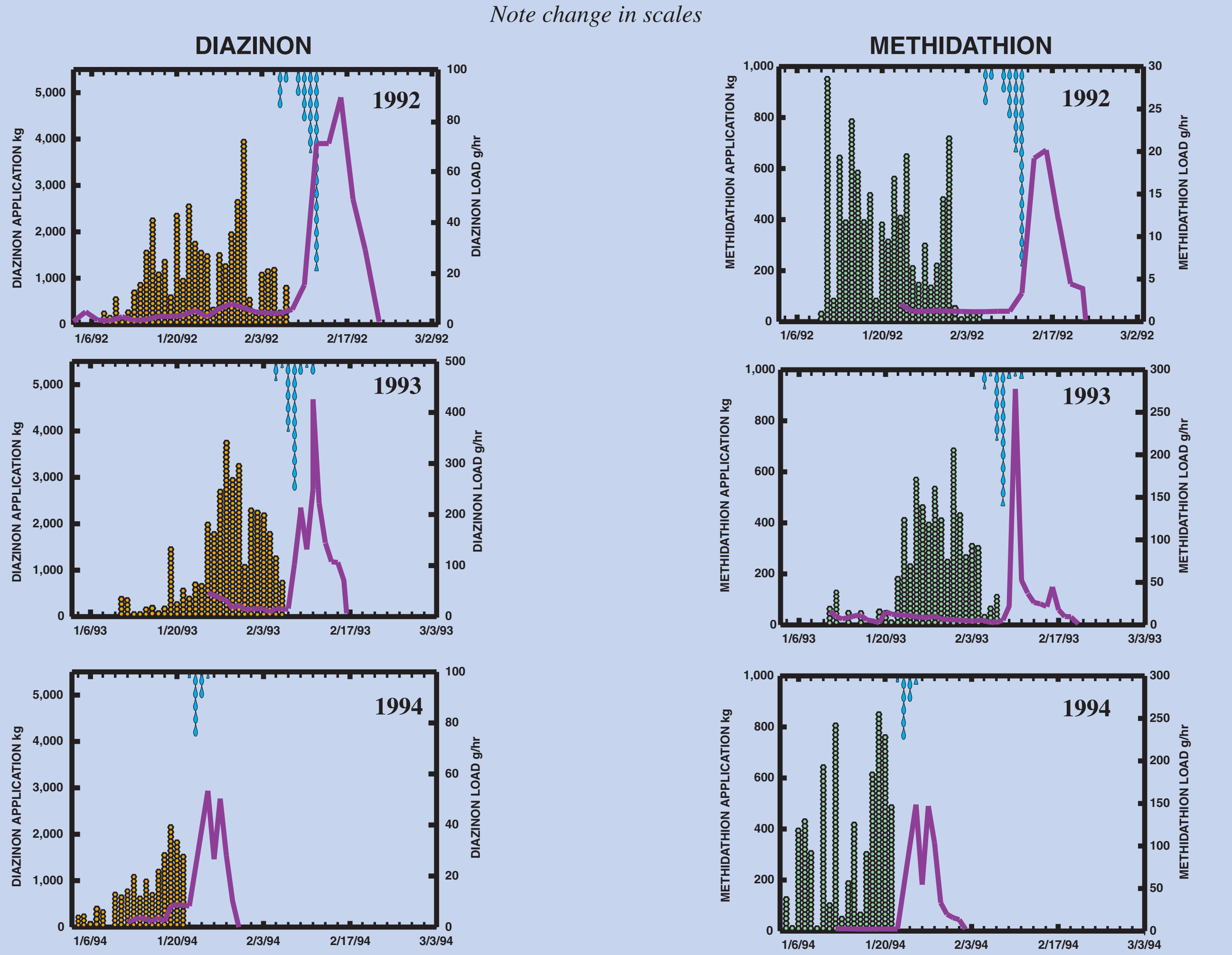
Annual Comparison



★ Methidathion concentrations below detection limit of 31 ng/L. Load calculated using half the detection limit.

San Joaquin River Watershed

Note change in scales

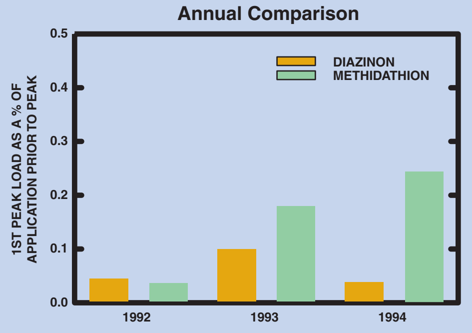


- Yearly trend in load varies between compounds (diazinon 93 > 92 > 94, methidathion 94 > 93 > 92)
- Pesticide loads vary by an order of magnitude from year to year and between compounds
- Amount and duration of pesticide application and rainfall vary from year to year

Does application amount alone account for annual variability in load?

- Normalize load to the amount applied (graphed as %)
- % load varies from year to year suggesting other factors are important
- Different year to year trend for two pesticides
- Early trend for load as percent of applied similar to load trend

Annual Comparison



Comparison of Loads

- Pesticide loads are not solely a result of pesticide application amounts
- Yearly trend in load is similar in Sacramento watershed but varies in San Joaquin by compound
- Diazinon trend similar for both watersheds (93 > 92 > 94)
- Methidathion trend varies between watersheds

Diazinon Load as % of Amount Applied

Year	Sacramento	San Joaquin
1992	0.27%	0.04%
1993	0.50%	0.10%
1994	0.17%	0.04%

Methidation Load as % of Amount Applied

Year	Sacramento	San Joaquin
1992	0.15%	0.03%
1993	0.33%	0.18%
1994	0.05%	0.24%

Watersheds are complex systems with pesticide loads influenced by a number of factors

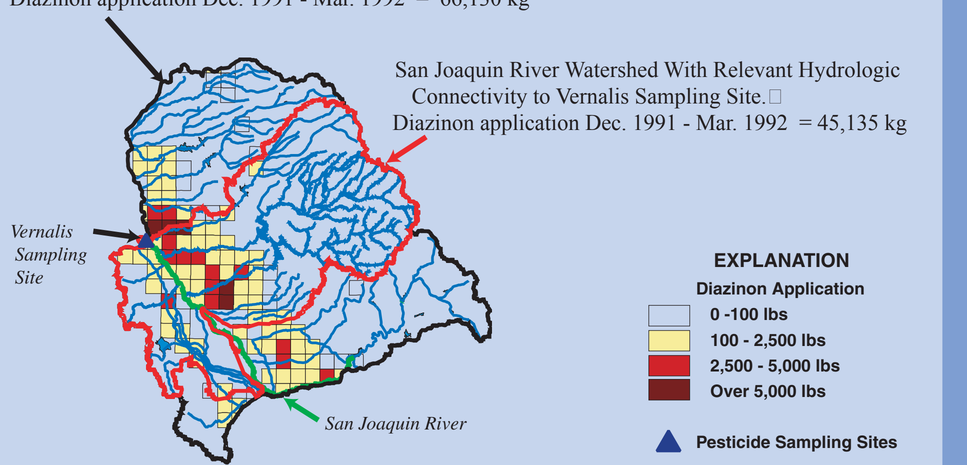
- Timing, amount, and location of pesticide application
- Timing, amount, location, and intensity of rainfall
- Chemical/physical properties of pesticides
- Inherent watershed characteristics such as soil type
- Hydrologic connection between field and river

Correct Watershed Definition

- Knowledge of basic watershed hydrology is key when comparing spatially dependent variables, such as pesticide application

General San Joaquin River Watershed
Diazinon application Dec. 1991 - Mar. 1992 = 66,130 kg

San Joaquin River Watershed With Relevant Hydrologic Connectivity to Vernalis Sampling Site.
Diazinon application Dec. 1991 - Mar. 1992 = 45,135 kg



Acknowledgements

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